User Autonomy Across Demographics in Mobile Health Applications

S. Anawar[1, 2], F.N. Mahmud[2], Z. Ayop[1, 2], E. Hamid[1, 2], W.H.Yeoh[2]

[1]Center of Advance Computing and Technology (C-ACT),
[2]Faculty of Information and Communication Technology
University Teknikal Malaysia Melaka.

syarulnaziah@utem.edu.my

***Abstract*—User autonomy is important to improve decision-making process in achieving the intended health goal in mobile health application. The objective of this paper is to investigate the significance of demographic factors on user autonomy in the case of mobile health applications. This study used quantitative method. A survey (N=125) of mobile health users in Malaysia attempted to identify individual's characteristics that relate to user autonomy and characterize the mobile health users with significant level of user autonomy. From the findings, this study concludes that there is significant difference in the level of perceived choice in mobile health usage across age and occupation groups.**

***Keywords*—autonomy; mobile health; user participation; demographics**

I. INTRODUCTION

THE use of smartphones and wireless technologies to improve the access to quality healthcare services through the mobile health paradigm may be able to promote healthy lifestyles and extend nationwide health monitoring and preventive care campaigns. With over five billion wireless subscribers across the globe [1], mobile health monitoring can be seen as an affordable tool for early detection to prevent non-communicable diseases (NCD) such as diabetes, hypertension, and heart diseases, while reducing the cost of healthcare due to reduced demand of health services. The motivation that drives the growth of mobile health development is to improve user participation in health monitoring campaigns. Previous studies have shown that participation is often short-lived, especially when it relates to self-monitoring health [2]. Therefore, service providers have shifted towards mobile health monitoring to increase participation.

An effective response requires that individuals and societies to be more responsible towards their own health. In line with the government's initiatives to improve citizens' wellbeing by enabling access to quality healthcare, mobile health paradigm will greatly give an impact to future healthcare services in Malaysia. A key aspect in mobile health monitoring is user autonomy. User autonomy is particularly important to ensure good user accessibility to the services and mobile health content delivery regardless of their background. Therefore, this paper seeks to address the importance of demographics factors in modifying the level of user autonomy during mobile health monitoring.

The aims of this paper is to investigate the significance of demographic factors on user autonomy in the case of mobile health applications. This study is important where users have to be part of the decision-making process to achieve the intended goal in mobile health application, and they should feel responsible and well-informed about the applications operation in making the decisions [3]. This study may serve as a basis for future research in incorporating users into the mobile health application design. The rest of this paper is organized as follows: The first part of the paper presents the literature review on user autonomy in mobile health application as the foundation for the proposed user autonomy

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variables. Next, the methodology is presented by explaining the instrument design and data collection. Then, this paper determines the significance of the demographic factors on user autonomy using non-parametric analysis for each demographic segment. Finally, this paper provides the discussion of the findings and conclude the paper.

II. LITERATURE REVIEW

The concept of autonomy in information technology has emerged from the literature in the past years. Deci and Ryan [4] argues that autonomy is one of three basic psychological needs to keep a person to be motivated in performing a task. Mittelstad [5] define *user autonomy* as "the ability to construct one's goals and values, and to have the freedom to make one's decisions and perform actions based on these decisions". Owens and Cribb [6] further suggest that autonomy in health means free deliberation and decision making about one's health. Anawar et al. [7] add that in mobile health context, participants exhibit a sense of autonomy when they feel that they have the ability to make a decision over the direction of the application task.

The need for autonomy for positive outcomes in mobile health application has been shown in numerous studies. Some of earlier studies of user autonomy can be seen in Mobile Access to Health Information (MAHI) [8][9] exercises self-direction and perceived-choice strategy to allow individuals to develop their own patterns of engagement when making dietary choices. The researchers show how individuals with diabetes to find a unique way to adopt the open application to construct and negotiate their identities as persons with a chronic disease [8]. In Ubifit [10], the system allows participants to specify their own weekly goal even though they are bound by the campaign regulation and requirement during data collection activities. The design decision is based on Goal-Setting theory that hypothesizes individuals will reach highest contribution when the goals are specific and created by themselves [11].

Albrecht and von Jan [12] emphasize that application developer must carefully take account of user autonomy by providing opportunity for all users to explore the application, to set purposes, and to decide what information to be recorded and shared with others in order to optimize the benefits of such application. Mobile health application must provide possibility for personalized support by permitting the content delivery and application features to be tailored to user's interests and need [13]. The use of wearable devices such as Fitbits for mobile health monitoring will increase user autonomy [6] and content delivery particularly to people with disabilities and older adults.

Prior to this study, a content analysis has been conducted that analyze set of autonomy features in 283 mobile health application that may encourage user autonomy in mobile health application. In our study [7], it was found that there is a clear trend of increasing number of user autonomy features, in which 88.3 percent of mobile health apps include at least one user autonomy features. Some of the user autonomy features in mobile health applications include Daily calorie tracker, Meal plan, Notes, User diary, Goal setting input and update, and User reminder.

Finally, the proposed variables to measure user autonomy based on our synthesis of literature in mobile applications are presented. The autonomy variables were extracted based on the criteria of user autonomy [14] as follows:

a. Self-direction: Individual have a freedom to conduct the direction of own task.
b. Perceived choice: individual have an ability to make decision of what to do.
c. Responsibility: individual exhibits affective attachment to their role in relation to goals and values.
d. Goal setting: Individual have control over goal that is important to them.

III. RESEARCH METHODOLOGY

This study used quantitative method where the researcher collects a sample of a population data and analyses the results statistically. The quantitative method begins with identification

of variables and formation of hypotheses. In this study, the set of autonomy variables namely self-direction, perceived choice, responsibility, and goal setting are deduced from two existing behavioral theories: Self-Determination Theory [4] and Motivation 3.0 [15].

A. Instrument Design

In this study, structured questionnaire was used for data collection. A questionnaire construction involved a few stages as adapted from O'Brien and Toms [16]. The questionnaire was divided into two parts namely Section A and B. Section A was to collect the demographic profile of the respondent and the data collected were nominal data. Section B was carried out to identify the level of autonomy possessed by a user of mobile health applications. Section B used the continuous data. Items in Part B were adapted from Treatment Self-Regulation Questionnaire [17] and General causality orientations scale [4]. 6-point Likert scale is used to rate the items, with 1 are classified as unlikely, and 6 is classified as most likely.

Content validity was carried out to verify the suitability of the research questions. It is also to verify the language used and investigate any biases. A total of four experts were chosen for the content validation purpose based on their expertise in the field of human-centered computing with a minimum experience of 5 years. The questionnaire is made bilingual (English and Malay), to ensure that those who are poor in English or finding it difficult to understand the sentence in English could refer to the Malay version. Given the scale was being administered to a substantially different population, reliability test is conducted using Kaiser-Meyer-Olkin (KMO) and Cronbach Alpha for each variable and set of items in that variable. The Cronbach alpha for self-direction, perceived choice, responsibility, and goal setting were 0.769, 0.759, 0.764, and 0.765 respectively.

B. Data Collection

A sample of 150 mobile health users were recruited from fitness center around Malacca and Kuala Lumpur. Respondent recruitment was also advertised through flyers. The survey was distributed through printed questionnaire. The data collection process took approximately three weeks to complete. Proportional quota sampling method is used in identifying the sample for data collection. This method is chosen as the targeted respondents are Malaysian online geosocial network users. Therefore, the proportion is based on the ethnic group of Malaysian population to reflect the Malaysia demography. Based on the information of Department of Statistics Malaysia, the proportion of ethnic group is 0.68:0.23:0.07:0.01 (Bumiputera: Chinese: Indian: Others) as in 2016 [18]. Quota is measured based on the sampling size. In total, 125 respondents were included in this study.

IV. RESULTS

This study used rank-based non-parametric test to compare the demographic factors that have different distribution. Total scores and subscale core medians by gender, age, ethnicity and occupation are presented in Table I, II, III, and IV. Kruskal-Wallis H-test is performed to see whether there is significant difference in the level of autonomy in Age, Ethnicity, and Occupation group, while Mann-Whitney test is performed to test see whether there is significant difference in the level of autonomy in Gender group. In this study, only the significant level of 0.01 was considered statistically significant, thus increasing strong evidence against null hypothesis.

A. Respondent Profiles

Four demographics criteria are collected in the survey; namely gender, age, ethnicity and occupation. Table I displays the summary of demographics. For gender, 80 out of 125 respondents are male which consists of 64% while 45 respondents are female (32%). For age group, group 21-30 years old have the highest frequency which is 81 (64.8%), followed up by group 31-40-year-old which has 20 respondents consist of 16%. Group 20 or younger have frequency of 15. The least age group belongs to group of more than 40 years of age which only has 9 respondents with a percentage of 7.2%.

TABLE I. RESPONDENT PROFILES (N=125)

Analysis Categories		Frequency	Percent (%)
Gender	Male	80	64
	Female	45	32
Age	<20	15	12
	21 to 30	81	64.8
	31 to 40	20	16
	> 40	9	7.2
Ethnicity	Malay/ Bumiputera	92	73.6
	Chinese	24	19.2
	India	8	6.4
	Other	1	0.8
Occupation	Student	59	47.2
	Employed	33	26.4
	Self-employed	28	22.4
	Unemployed	5	4

Based on the proportional quota mentioned in sampling method, 92 Bumiputera, 24 Chinese, 8 Indian, and one from other races are chosen as respondents. Four types of occupation are identified which are Student, Employed, Self-employed, and unemployed. For students, there are 59 respondents which consist of 47.2% in the sample. Employed and unemployed groups have similar frequency which is 26.4 and 22.4 respectively. Unemployed group has the least respondents (5, 4%).

B. Gender

The first comparison is performed on gender groups. Table II provides the results for Mann-Whitney test which is utilized to compare two independent gender groups in the study. The test returns the significance (p = 0.423) for Self-directed, significance (p = 0.763) for perceived choice, significance (p = 0.659) for responsibility, and significance (p = 0.703) for goal setting. Since all null hypotheses for all autonomy variables are accepted, this study concludes that there is no significant difference between gender groups on all autonomy variables.

TABLE II. DESCRIPTIVE STATISTICS BY GENDER

Analysis Categories		Gender	
		Male (N=80)	*Female (N=45)*
Self-Directed	Median	3.0000	3.5
	Std. Deviation	0.73030	0.65060
	Sig. Mann-Whitney	0.423	
Perceived Choice	Mean	4.0000	4.0000
	Std. Deviation	1.19042	0.99359
	Sig. Mann-Whitney	0.763	
Responsibility	Mean	4.0000	4.0000
	Std. Deviation	0.90568	0.89909
	Sig. Mann-Whitney	0.659	
Goal Setting	Mean	3.5000	3.5000
	Std. Deviation	0.89690	0.78606
	Sig. Mann-Whitney	0.703	

C. Age

Table III presents the median of user autonomy variables by age group. From the four variables, the group of more than 40 years of age are likely to have higher level of autonomy in using mobile health applications, but not statistically significant. The result of Kruskal-Wallis H test shows that there is significant difference in the level of perceived choice across the categories of ethnic group, where group of age 20 or younger have highest level of perceived choice compare to other age groups.

TABLE III. DESCRIPTIVE STATISTICS BY AGE

Analysis Categories		Age			
		< 20 (N=15)	*20—30 (N=81)*	*30-40 (N=20)*	*> 40 (N=9)*
Self-Directed	Median	3.0000	3.0000	3.5000	4.0000
	Std. Deviation	0.69007	0.74817	0.56230	0.70711
	Sig. Kruskal Wallis	0.170			
Perceived Choice	Mean	4.5000	3.5000	3.5000	4.0000
	Std. Deviation	1.34990	1.12994	0.94514	1.13205
	Sig. Kruskal Wallis	0.008**			
Responsi-bility	Mean	4.0000	4.0000	4.0000	4.0000
	Std. Deviation	1.25167	1.89497	0.98406	0.95743
	Sig. Kruskal Wallis	0.168			
Goal Setting	Mean	3.5000	3.5000	3.5000	4.0000
	Std. Deviation	0.54772	0.73232	0.86431	0.5000
	Sig. Kruskal Wallis	0.521			

[a] **Indicates significance at p < 0.01 level.

D. Ethnicity

Table IV tabulates the median of user autonomy variables by ethnic group. From the four subscales, the Bumiputera, Chinese, and Indian are likely to have higher level of Perceived Choice and Responsibility in using mobile health applications. However, based on the result of Kruskal-Wallis H test and Mood's median test, there is no significant difference in the level of autonomy across the categories of ethnic group.

TABLE IV. DESCRIPTIVE STATISTICS BY ETHNICITY

		Ethnicity			
		Malay/ Bumi (N=92)	***Chinese (N=24)***	***Indian (N=8)***	***Others (N=1)***
Self-Directed	Mean	3.5000	3.5000	3.0000	3.0000
	Std. Deviation	0.68777	0.80475	0.63246	.0000
	Sig. Kruskal Wallis	0.570			
Perceived Choice	Mean	4.0000	4.0000	4.0000	4.0000
	Std. Deviation	1.11300	1.15189	1.18773	.0000
	Sig. Kruskal Wallis	0.363			
Responsi-bility	Mean	4.0000	4.0000	4.0000	2.0000
	Std. Deviation	0.89612	0.95005	0.53452	.0000
	Sig. Kruskal Wallis	0.256			
Goal Setting	Mean	3.5000	3.5000	3.0000	3.0000
	Std. Deviation	0.88863	0.74001	0.75593	.0000
	Sig. Kruskal Wallis	0.436			

E. Occupation

Table V tabulates the median of user autonomy variables by occupation. From the four variables, students, employed, self-employed, and unemployed are likely to have higher level of Responsibility in using mobile health applications. In addition, employed respondents are less likely to have perceived choice in using mobile health applications. The result is supported by Kruskal-Wallis H test that shows there is significant difference in the level of perceived choice across the categories of occupation with $p < 0.01$.

TABLE V. DESCRIPTIVE STATISTICS BY OCCUPATION

Analysis Categories		Occupation			
		Student ((N=59)	***Employed (N=33)***	***Self-employed (N=28)***	***Un-employed (N=5)***
Self-Directed	Mean	3.0000	3.5000	3.5000	4.0000
	Std. Deviation	0.59215	0.69823	0.67843	0.57735
	Sig. Kruskal Wallis	0.421			
Perceived Choice	Mean	4.0000	3.5000	4.5000	4.0000
	Std. Deviation	1.11967	0.84864	0.89848	1.51658
	Sig. Kruskal Wallis	0.004**			
Responsi-bility	Mean	4.0000	4.0000	4.5000	4.0000
	Std. Deviation	0.84890	0.87175	0.61306	1.51658
	Sig. Kruskal Wallis	0.088			
Goal Setting	Mean	3.5000	3.5000	3.5000	3.0000
	Std. Deviation	0.85780	0.83489	0.75428	1.22474
	Sig. Kruskal Wallis	0.407			

[b.] **Indicates significance at $p < 0.01$ level.

V. DISCUSSIONS

The aim of this study is to determine the level of user autonomy in using mobile health application. From the findings, it can be seen that among four demographic factors that have been tested, there is no significant difference in the level of autonomy in Gender and Ethnicity group. On the other hand, the results of the Kruskal-Wallis test indicate that there is significant difference in the level of autonomy in age and occupation group. Additionally, observing the median value for likelihood of user autonomy behavior suggest that the respondents who participated in this study generally are less likely to have self-direction and goal setting behavior in using mobile health applications. Further observation of the findings shows that there is significant difference in the level of perceived choice across age and occupation groups.

The findings indicate that users' age may influence perceive choice when using mobile health applications. Possible explanation of this finding may be due to a person in certain categories of age may have different ability in choosing the activity that they want to perform. From the findings, it can be seen that the respondents with age 20 and below has the highest level of perceive choice compare to other age categories. In general, respondents

in this age are at state where they are very active and have the most energy. They have freedom to choose different type of health and physical related activities compare with other age categories. Although users with age 20 to 40 may be considered as active age as well, their perceived choice may be limited due to time barrier in exploring the activities of the applications, as most of the respondents under these age categories are studying or working. The finding corroborates with previous study in online learning [19] that cited time management as a challenge that may limit users in keeping up with the online learning activities.

Besides age, there is significant difference in the level of perceived choice between the type of occupations. Some people might face problem to apportion their time between work and other activities especially those who have career and commitment in their life. The individuals that are working need to segregate their working time to ensure they have time to stay healthy and fit. On the other hand, if they still want to spend some time to exercise, they need to do fair and wise judgement where they need to choose exercises that would not consume so much of their time. This means that individual that already in working phase need to focus on their working life. Particularly, most of employed worker have no time to exercise due to workload that they have where they do not even have enough time for themselves.

VI. CONCLUSION

In conclusion, this study investigates the significance of demographic factors on user autonomy while using mobile health applications. Four user autonomy variables are investigated in this study namely self-direction, perceived choice, responsibility, and goal setting. A survey has been conducted and the non-parametric analysis is used to analyze significant difference in the level of autonomy in Age, Ethnicity, and Occupation group. The findings indicate that there is significant difference in the level of perceived choice across age and occupation groups. In addition, the result shows that respondents generally are less likely to have self-direction and goal setting in using mobile health applications. Further study will include analysis on the association of the demographic factors with user autonomy variables using correlation analysis.

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